CARCINOMA OF THE STOMACH

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MANY renowned surgeons have directed attention to the subject of gastric carcinoma since Billroth performed the first successful partial gastrectomy for this lesion in 1881 (Billroth, 1881) and Schlatter accomplished the first total gastrectomy in 1897. Although advances have been made in the diagnosis and treatment of gastric cancer since the work of these pioneers, I am sure we would all agree that even our most competent efforts of today leave much to be desired. It is natural that the names of surgeons are prominent in the literature relating to gastric malignant disease, since no patient, to my knowledge, has ever been cured of gastric carcinoma except by surgical removal of the growth. Although a review of past work is always of interest, no historical account will be given at this time, as I would prefer to discuss some current controversial phases and to report on experiences which my associates and I have had in the recognition and management of patients who have gastric cancer.

Etiologic factors that might be responsible for development of various types of malignant lesions have been the object of many detailed and specific studies. Certain general data also stimulate thought and might possibly provide clues regarding etiology if they could be properly studied and evaluated. For example, there has been much comment during recent years about the increased incidence of pulmonary cancer. Equally intriguing is the great difference in relative incidence of gastric carcinoma in various countries. Interesting also, and possibly presenting easier investigative possibilities, is the difference noted in relative incidence of gastric carcinoma in various parts of the same country (Haenszel, 1958). The age-adjusted death rate from cancer of the stomach is highest in Japan, Finland, and Chile. In fact, it was found that during the years 1951 to 1954 it was between two to three times higher in these countries than it was in Ireland, England, or the United States. An undoubtedly significant but unexplained fact is that age-adjusted death rates for cancer of the stomach have decreased significantly in some countries but not in others (Moore, 1962; Segi, 1960) (see figure). This decrease started in the United States thirty or more years ago and has been rather pronounced. In contrast, the same change has not occurred in Northern Ireland or England (Segi, 1960). Many theories have been advanced to explain the geographic and national differences in the relative

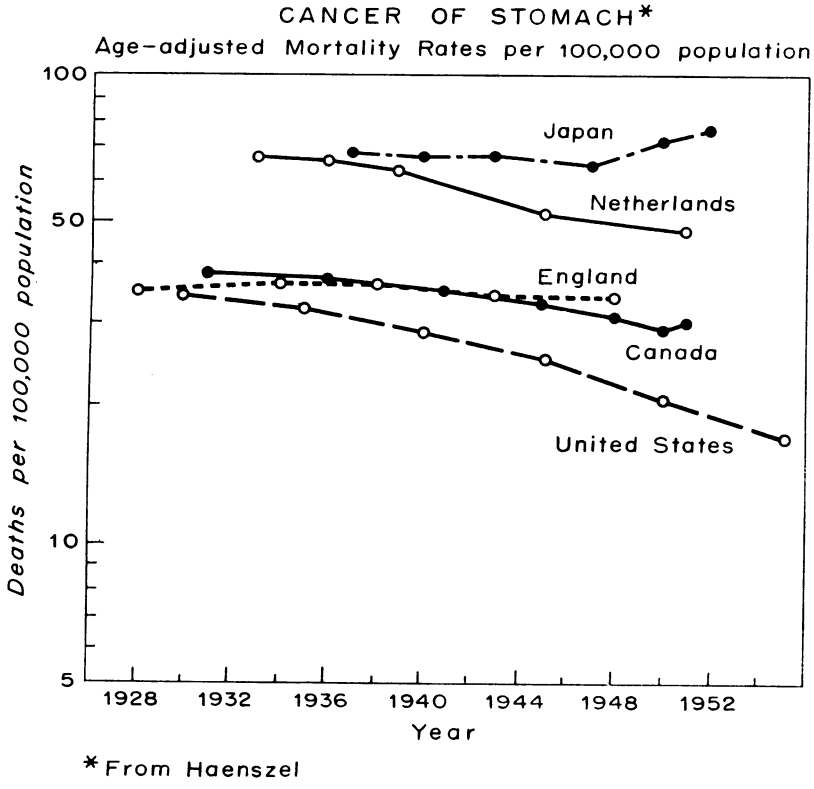

Figure. Incidence of and trends in frequency of gastric cancer in certain countries (from Haenszel, 1958).

frequency and changing incidence of deaths from cancer of the stomach, but no well-substantiated explanation has been forthcoming. As might be expected, the role played by diet and dietary habits has been the source of much speculation.

That many patients have been cured of gastric carcinoma for five, ten, fifteen years or longer by appropriate surgical treatment is well attested by the literature (Brown et al., 1961; Eker and Efskind, 1960; Fly et al., 1958; Gage et al., 1956; Lewin, 1960; Merlo et al., 1960; Pack and McNeer, 1948; Walters et al., 1942; Welch and Wilkins, 1958). This is an important fact to remember since a defeatist attitude concerning gastric carcinoma is sometimes expressed. Some authors state that "biologic predeterminism" rather than the time or type of operation governs end results in gastric carcinoma (McDonald and Kotin, 1954). While the balance between host resistance and tumour aggression is an admittedly important factor in the outcome of any patient who has a malignant lesion, it is not, I believe, the only factor which influences prognosis. The surgeon's viewpoint in this matter

is of some importance, since it may significantly influence his entire approach to a patient who might have carcinoma of the stomach.

Duration of Symptoms in Relation to Surgical Treatment and Survival Rates after Resection of Gastric Cancer.

The theory of "biologic predeterminism" in regard to patients having gastric carcinoma has been supported repeatedly in the literature by statements that a long preoperative history affords as good or better chance for five-year survival after surgical removal of the lesion than does a short preoperative history (Blalock and Ochsner, 1957; Brown et al., 1961; McDonald and Kotin, 1954; McNeer et al., 1958). It might be added that other reports of this type have been made which have not been limited to gastric malignant lesions (Cabot and Berkson, 1939). Observations of this type obviously conflict with the long-accepted view that early diagnosis and treatment are important in prognosis for the patient who has a malignant lesion.

Further study of the significance of duration of symptoms prior to surgical treatment for gastric carcinoma was undertaken recently (Barber et al., 1961) and led to some interesting findings. The records of all patients having a diagnosis of gastric carcinoma and seen initially at the Mayo Clinic during the years 1950 through 1953 were reviewed. There were 1,121 patients in all; 928 (82.8 per cent.) were operated on, and gastric resection was performed in 572, which was 61.6 per cent. of those operated on and 51 per cent. of the total group.

It was found, as in previous studies, that the percentage of patients considered clinically to have an inoperable lesion and who therefore were not subjected to operation (17.2 per cent. of the total group of 1,121 patients) was virtually the same, whether symptoms had been present for two months or less prior to operation, or for three to five months, six to eleven months or one year or longer. The same was true for patients who had undergone gastric resection, some palliative surgical procedure, or only abdominal exploration. Obviously such findings do not suggest that early diagnosis is important in the outlook for the patient with gastric cancer. Likewise, when patients who had undergone gastric resection for gastric carcinoma were divided into groups according to duration of preoperative symptoms, it was found that those who had a short history prior to operation had no better five-year survival rate than those who had a long history.

In further search of some explanation for these findings, earlier studies on patients who had small gastric cancers were recalled (Comfort et al., 1957; Gage et al., 1956). In these studies it was noted that approximately 25 per cent. of 1,541 gastric adenocarcinomas removed during a ten-year period measured 4 cm. or less in their greatest diameter. It was also noted that the postoperative five-year survival rate for patients who had gastric carcinomas that measured 4 cm. or smaller was definitely higher than that for patients whose lesions were larger than 4 cm. It is known that many patients with small gastric carcinomas (4 cm. or less in diameter) have a long history suggestive of gastric ulcer, a diagnosis which has been made previously in many of these patients. When five-year

survival rates are determined separately for patients who are found to have small (4 cm. or less in diameter) gastric cancers and those who have larger lesions, a significant difference is noted, depending on the duration of symptoms prior to operation.

Thus, it was found that the five-year survival rate was 24.3 per cent. for 305 patients who had symptoms of less than twelve months' duration prior to operation and who had carcinomatous lesions that were more than 4 cm. in diameter. In contrast, the five-year survival rate was only 11.9 per cent. for 101 patients who underwent removal of lesions of the same size but who had preoperative symptoms for twelve months or longer. This is in contrast with those patients who had gastric carcinomas 4 cm. or less in diameter. In this group it was found that only 28.6 per cent. of those who had symptoms of two months' duration or less survived five years after removal of the lesion, whereas 59.6 per cent. of those who had symptoms for three months or longer prior to operation survived five years or more. In this study it was also found that the entire group of patients with small gastric cancers (4 cm. or less in diameter) had a five-year survival rate of 54.2 per cent. after removal of the lesion in contrast to a five-year survival rate of only 21.2 per cent. for those who had larger carcinomas resected. Forty-five per cent. of patients with small lesions had symptoms for more than one year prior to operation in contrast with only 25 per cent. of those who had larger lesions.

Consideration of these data affords some clarification of the numerous reports referred to previously which indicate that a short preoperative history does not improve the outlook for the patient with gastric cancer. Without going into detail, it might be added that although in our experience only 25 per cent. of the patients who have had gastric cancer resected have had a lesion that measured 4 cm. or less in diameter, a relatively large percentage (43 per cent.) of all so-called five-year cures of gastric carcinoma, regardless of size, have come from this group. Patients with these small lesions, as a group, present a definitely longer history of symptoms than those patients who have larger lesions. Without endeavouring to be specific, it seems obvious that certain fundamental differences exist between the small gastric cancer and the larger lesion. It is also known that the duration of symptoms is not necessarily synonymous with the duration of the malignant process. It appears likely that many patients found to have a small gastric cancer at the time of operation may have had symptoms caused by benign gastric ulcer prior to development of gastric cancer.

Much evidence, accumulated over many years, indicates that removal of gastric cancer before extension to the serosa, lymph nodes, or adjacent structures has occurred provides a better prognosis than operation performed after spread to these regions. Detection of gastric cancer in a truly early stage probably requires its discovery before symptoms occur, which poses a large problem. Even though considered desirable, which is highly doubtful, it is not feasible to perform rœntgenologic examination of the stomach periodically on all adults. On the other hand, such studies on selected persons have yielded some interesting results.

Rœntgenologic examination of the stomach is carried out at the Cancer Detection Centre of the University of Minnesota on persons 50 years of age or older who have achlorhydria or pronounced hypochlorhydria after stimulation with histamine. A study from 1948 to 1956 showed some gastric abnormality in 5.6 per cent. of all patients in whom rœntgenologic examination of the stomach was performed (Hitchcock, 1957). An actual gastric malignant lesion was discovered in 20 per cent. of the persons whose rœntgenograms showed evidence of a gastric abnormality or 1.1 per cent. of the entire group. The commonest lesions found were gastric polyps, gastric ulcers, gastric malignant lesions and a "suspicious area" in the stomach. As this entire group of patients is followed longer, it seems likely that additional abnormal findings will occur. Of the patients in whom gastric malignant lesions were found and removed surgically, only 10 per cent. had involvement of the lymph nodes. This is in sharp contrast with those in whom operation had been performed after the existence of symptoms for variable periods. The relatively frequent association of pernicious anæmia and gastric cancer is adequate reason for all patients with pernicious anæmia to have periodic rœntgenologic examinations of the stomach. I believe the evidence suggests that early diagnosis and surgical treatment are of value for the patient who has gastric cancer.

Gastric Ulcer and Other Presumed Benign Conditions.

Another broad subject which has received much attention for years concerns the differential diagnosis of benign gastric ulcer, the relationship which this lesion may have to gastric cancer, and appropriate management of the patient who is found to have gastric ulcers. Without going into detail, I might say that it is my opinion that surgical treatment usually is advisable for the patient who has a chronic gastric ulcer. This view is held (1) because long-range results of medical treatment for gastric ulcer leave much to be desired, (2) because of the possibility that a malignant lesion is being overlooked, (3) because of the low risk of operation, and (4) because favourable results are obtained by surgical treatment.

In a careful study of 664 patients treated medically for presumed benign gastric ulcer and followed for five to eleven years after institution of medical treatment, it was found by Larson, Cain, and Bartholomew (1961) that only 21.7 per cent. had complete symptomatic relief with permanent healing of the ulcer. Operation became necessary in 43 per cent. of the 664 patients, and gastric cancer was found subsequently in 8.9 per cent. of the entire group. In a smaller group of 391 patients who were treated medically for gastric ulcer and who were followed for ten to nineteen years, the rate of incidence of gastric cancer was 12.2 per cent. (Larson et al., 1961). Surgical treatment of patients with chronic gastric ulcer not only affords lasting relief of symptoms in a high percentage of patients but also permits removal of a lesion which might subsequently prove to be malignant. If a malignant lesion actually is found at operation, its removal is accomplished at a time that offers a more favourable prognosis than could be offered if operation were postponed for months or longer.

In thinking of detection of gastric malignant disease in its early stages, before a serious and extensive lesion has developed, the gastric polyp probably has not received adequate attention. One study on gastric polyps indicated that of three hundred patients in whom the rœntgenologic diagnosis of gastric polyp or polyps was made and operation subsequently was performed, approximately 60 per cent. were found to have polyps, 20 per cent. other benign lesions, and 20 per cent. a malignant lesion (Huppler et al., 1960). It is apparent from this study that the rœntgenologic diagnosis of gastric polyp includes some patients who actually have malignant lesions. There were 206 of the three hundred patients in this study who were found to have gastric polyps at the time of operation and in twenty-five of these (12 per cent.) the polyps showed evidence of malignant change. The rate of incidence of malignant disease was found to be 14 per cent. when multiple polyps were present, in contrast with 9 per cent. when there was only a single polyp. In ninety-four of the three hundred patients, benign or malignant lesions other than gastric polyps were found at operation.

In attempting to establish a correct differential diagnosis of a gastric lesion there are other findings which should always arouse suspicion regarding the possible existence of a malignant lesion. These include any recurrent gastric ulceration, gastric (in distinction from gastrojejunal) ulceration after previous gastrœnterostomy or gastric resection, or significant change in the nature of symptoms experienced by a patient in whom the diagnosis of a benign gastric lesion, usually an ulcer, has been made previously. The rœntgenologist is of greatest help in establishing a diagnosis of gastric cancer, but he is not infallible any more than anyone else, and it should be considered that there is at least a 10 per cent. chance of error in his differential diagnosis of benign or malignant gastric ulcer. In addition, rœntgenologic diagnosis should be viewed with suspicion when "persistent narrowing" is reported in the stomach and when duodenal ulcer or "pyloric obstruction" is reported in the presence of achlorhydria or definite hypochlorhydria. It hardly seems necessary to state that no patient should be treated medically for symptoms presumably caused by benign peptic ulceration without the benefit of rœntgenologic examination of the stomach and duodenum.

Cytologic Study of Gastric Washings.

A diagnostic procedure which has received increasing attention during recent years is that of cytologic study of the gastric content. Various techniques have been employed to obtain specimens of gastric content which are suitable for microscopic examination and most likely to permit an accurate diagnosis. Experiences reported in the literature vary with the type of patient studied, the methods and procedures employed, and the experience of the cytologist. Seppälä (1961) summarized thirty-six different reports, including the more significant studies made from 1947 to 1961. The largest series is that of Schade (1960), who reported a total of 3,280 examinations. He used the saline lavage technique, and reported that 90.5 per cent. of 258 cases of gastric carcinoma were correctly diagnosed. False positive cytologic reports were made in 5 per cent. of the non-malignant cases. Seppälä (1961) reported in his own study of 736 patients that

cytologic examination gave findings indicative of malignant disease in 80.5 per cent. of patients with gastric cancer and a false positive rate of 1.9 per cent. Our experience (Rovelstad, unpublished), last reviewed in 1960, is more modest and does not reveal so high a degree of accuracy. A correct positive diagnosis of gastric cancer was made in 17 of 25 patients (68 per cent.). No false positive reports were obtained in a larger control group. Actually, in our entire group of 142 patients, we found only one or possibly two patients in whom cytologic study made a significant contribution to diagnosis and management. Perhaps, as our experience grows and methods improve, this type of study will prove to be of greater value, although in 370 patients studied to date and admittedly incompletely reviewed, we have seen little to offer promise of greater expectations from this procedure (Rovelstad, 1960).

Surgical Treatment.

When exploration shows gastric carcinoma, the surgeon must decide the procedure of choice. This decision will be based not only on the findings, such as local extension of the growth or the presence of metastasis, but also on his experience with and philosophy of the surgical treatment of cancer. While it is difficult to be dogmatic regarding surgical indications, because of the numerous factors that must be considered in individual patients, my associates and I have followed certain general principles which I will mention before results of treatment are reviewed.

If the lesion is confined to the stomach, except perhaps for extension to regional lymph nodes, operation with hope of cure is undertaken. If the lesion can be completely removed by subtotal gastric resection, leaving at least a portion of the stomach attached to the œsophagus, this is done. Such a procedure routinely involves removal of the greater omentum and dissection of all areas of regional lymphatic drainage. The spleen has not always been removed when the lesion involves only the distal portion of the stomach, although there is evidence to suggest that removal is advisable (Fly et al., 1956). For lesions in the proximal portion of the stomach the spleen is routinely removed. Total gastrectomy, which always includes splenectomy, is reserved for the patient in whom subtotal gastrectomy will not remove all areas of malignant involvement. Over the years my associates and I have performed total gastrectomy in 18 to 20 per cent. of patients in whom gastric malignant lesions have been resected. Total gastrectomy is not employed when it is apparent that, at most, it would be only a palliative procedure. No portion of the pancreas is removed unless findings at operation suggest extension to this region.

More difficult surgical decisions may be required when the growth has extended beyond the stomach and perhaps has involved the transverse colon, pancreas, liver, retroperitoneal tissues, or other near-by structures. It has been our practice to remove the growth en masse under these circumstances when, in the opinion of the surgeon, this can be done in a complete manner. In some patients it is difficult or impossible to be sure of this point until some mobilization of the lesion has been accomplished. Local extension may be responsible for considering

a lesion inoperable, but this is not often the case. Although it seems unlikely that more and more radical operations will be responsible for great increase in survival rates, it is our belief that whenever a malignant gastric lesion can be completely removed, by any reasonable procedure, this should be done.

When abdominal exploration reveals multiple hepatic or other distant metastasis, the opportunity for cure probably has passed. Under these circumstances, it is not our practice to proceed with a radical operation. Palliative partial gastric resection is performed if the nature and extent of the growth permit this procedure to be done in a reasonable manner and without the necessity of total gastrectomy. Removal of an obstructing or bleeding carcinoma situated in the distal part of the stomach may afford considerable palliation. Gastroenterostomy may be used in other cases if resection of the lesion does not seem reasonable and if some degree of obstruction exists; however, the amount of palliation obtained by this operation is less than that obtained if the growth is removed.

Other procedures such as gastrostomy, jejunostomy, or insertion of a plastic tube through the site of an obstructing gastric growth are seldom employed. In patients in whom the growth is not removed, irradiation or the use of anti-cancer drugs may be employed. While these modalities of therapy have provided significant palliation for some patients, to date this has not been true for the majority. In our experience, use of 5-fluorouracil has given temporary subjective improvement in approximately half of the patients with carcinoma of the stomach in whom it has been used and objective evidence of improvement in about a fourth of them (Reitemeier and Moertel, unpublished). Reactions to this treatment may be unfavourable, and it is not recommended indiscriminately. It is hoped that more effective drugs may become available.

In operation for gastric cancer it is important to resect portions well above and below any extension of the malignant process in the stomach or duodenum and to remove regions of possible lymphatic involvement. Except for patients in whom there is an unusual degree of mucosal or submucosal spread of gastric carcinoma, the surgeon usually can form a fairly reliable opinion of the upper limit of extension of the growth by careful palpation and inspection of the stomach. As additional help in this regard, the surgical pathologist routinely makes multiple frozen sections of the upper and lower lines of resection to determine whether there is any microscopic evidence of malignancy. While information provided by this means may not be completely reliable, it has been our experience that it is seldom in error. Multiple areas of neoplastic involvement in the stomach may occur, but this is uncommon in the absence of gross evidence of neoplasm.

It is difficult to say specifically how far above or below a growth the line of resection should be placed. In this regard a study by ReMine and associates (1953) is of interest. In this work an effort was made to determine any differences in the surgical specimens which were removed from two different groups of patients. All patients in both groups had gastric resection performed for gastric carcinoma with metastatic involvement of regional lymph nodes. All patients in one group lived five or more years after operation, and all patients in the other group survived operation but died within one year. Measurements made between

the line of resection and the nearest edge of the lesion both above and below the growth, although virtually identical in both groups, averaged slightly longer for those patients who survived less than a year than for those who survived five years or more. From these data it would appear that removal of excessive amounts of uninvolved stomach does not improve prognosis for the patient with gastric cancer.

TABLE 1.

LOCATION OF METASTATIC LYMPH NODES IN PATIENTS WITH SHORT-TERM AND LONG-TERM SURVIVAL AFTER GASTRIC RESECTION.

LOCATION OF INVOLVED NODES	SURVIVAL OF PATIENTS, PER CENT.	
	Long-term*	Short-term†
Lesser curvature only - - -	64.6 ...	38.3
Greater curvature only - - -	14.8 ...	2.9
Both curvatures - - - -	20.6 ...	58.8
Subpyloric region - - - -	5.9 ...	70.6

*All patients lived five or more years after operation.
†All patients survived operation but died within one year

Of particular interest in this study were the findings in reference to involvement of lymph nodes (Table 1). The number of lymph nodes involved and their location proved to be significant in relation to length of postoperative survival. Involvement of lymph nodes along only the lesser or greater gastric curvature was noted more frequently in the group of long-term survivors than among the short-term survivors. The opposite was true when nodes along both curvatures were involved. Of particular significance was the finding that subpyloric nodes were involved in only 5.9 per cent. of the long-term survivors whereas this finding was present in 70.6 per cent. of the short-term survivors. Since this study we have given more attention to complete removal of all lymph nodes in the subpyloric area.

Other studies of importance to the surgeon include those which have demonstrated the frequency of spread of gastric cancer into the duodenum (Coller et al., 1941; Castleman, 1936). Marvin (1947) studied surgical specimens removed from one hundred patients in whom gastric resection had been performed for gastric carcinoma which involved the prepyloric portion of the stomach. Microscopic evidence of extension into the duodenum was found in 38 per cent. of this entire group. This extension was not always apparent grossly. The need to remove several centimetres of duodenum whenever the prepyloric portion of the stomach is involved with carcinoma is apparent. Spread from a gastric cancer to splenic hilar nodes has been reported to occur in 17.5 to 36.9 per cent. of cases.

An appropriate operation for gastric cancer obviously requires appreciation of the pathologic characteristics and the methods of spread of the lesion to be removed. Details of surgical technique will not be reviewed, but it might be emphasized that proper routine operation for cancer of the stomach includes complete removal not only of the lesion itself but also of all areas of primary lymphatic drainage, especially those around the origin of the left gastric arteries and those in the duodenohepatic area, the region of the head of the pancreas, the hilus of the spleen, and the omentum.

For partial gastrectomy I prefer the posterior Hofmeister-Polya type of anastomosis with attachment of the distal limb of the jejunum to the greater curvature of the stomach. When high subtotal gastrectomy is performed, a posterior anastomosis may not be feasible, and the jejunal loops are then brought anterior to the transverse colon. Adequate removal of the proximal portion of the duodenum and subpyloric lymph nodes does not usually permit a Billroth I type of anastomosis under favourable circumstances. Operative mortality rates associated with subtotal gastrectomy performed for cancer have averaged about 6 to 7 per cent. during recent years.

When total gastrectomy is performed, end-to-side œsophagojejunostomy with an entero-anastomosis is the routine procedure. It is varied only under special circumstances. The anastomosis between the jejunal limbs, in addition to providing drainage of the proximal limb, is helpful in preventing reflux of duodenal content into the œsophagus, which might produce œsophagitis. A Roux-Y type of end-to-end œsophagojejunostomy is employed if the mesentery of the jejunum is short and does not permit establishment of an end-to-side œsophagojejunostomy without tension on the anastomosis. End-to-end œsophagoduodenostomy is used infrequently because adequate removal of the duodenum usually does not make such an anastomosis feasible, and, in addition, œsophagitis may result from reflux of duodenal content under these circumstances. We have had practically no experience with use of a segment of colon or jejunum interposed between the œsophagus and duodenum.

Inasmuch as no patient with cancer of the stomach has been cured except by removal of the lesion, so far as I know, it is important that every patient with cancer of the stomach be considered a prospect for operation unless definite objective findings, such as distant metastasis, indicate the virtual impossibility of total surgical removal of the malignant process. "Operability rate" may be defined as the ratio (expressed in per cent.) of the number of patients subjected to laparotomy to the total number of patients with the diagnosis of cancer whose lesion was considered too far advanced to warrant even surgical exploration. A review of our experience in this regard indicates operability rates of 60, 80, and 90 per cent. for the years 1907 through 1939, 1940 through 1949, and 1950 through 1959, respectively. Thus, in recent years, only about 10 per cent. of patients with gastric cancer are not afforded the possible benefits of abdominal exploration.

Obviously, the surgeon always endeavours to resect the lesion at operation, if this seems to be a reasonable procedure. The "resectability rate," as used in

these data, may be defined as the ratio of patients (expressed as per cent.) in whom gastric cancer is resected to the total number of patients in whom operation is performed. It is noted that this rate has increased from 45.5 per cent. during the years 1930 through 1939 to 60.8 per cent. during the years 1950 through 1959 (Table 2). Unfortunately, the reason for this increase in proportion of

TABLE 2.

RESECTABILITY RATE OF GASTRIC CANCER IN SUCCESSIVE PERIODS

PERIOD	TOTAL OPERATIONS PERFORMED	RESECTIONS	
		Number	Per Cent.
1907-1919	1902	760	40.0
1920-1929	2456	1146	46.7
1930-1939	2301	1048	45.5
1940-1949	2945	1638	55.6
1950-1959	2213	1345	60.8
TOTAL	11817	5937	50.2

patients for whom resection is performed is not that less-advanced lesions have been seen. This is evidenced by the fact that the percentage of cases with lymph node involvement is greater at present than it was in the earlier years. This is important in relation to interpretation of reported survival rates after operation for these years.

OPERATIVE MORTALITY.

Although the risk of operation for a patient with gastric cancer has been lowered significantly during the past fifty years, this decline in operative mortality has been much less marked in the last two decades than it was in the previous three decades. This is no doubt true of many surgical procedures which have been performed during the same period. For example, for the period 1907 through 1939 the operative mortality rate (all hospital deaths) for partial gastrectomy for cancer was 16.0 per cent. and that for total gastrectomy was 65.6 per cent. In contrast, from 1940 through 1959 the operative mortality rate for partial gastrectomy dropped to 6.6 per cent. and that for total gastrectomy to 18.6 per cent. During the years 1950 to 1960 the operative mortality rates for partial and total gastrectomy were 6.7 per cent. and 15.4 per cent. respectively. Some surgeons have reported rather low operative rates for total gastrectomy

in relatively small series of cases. In our experience the risk of this operation has always remained definitely higher than that for partial gastrectomy.

Other factors which influence operative mortality for patients with cancer of the stomach, but which are not limited to patients with cancer of the stomach, include age and sex. Operative risk increases with age and has always been lower for women than for men. Thus, from 1950 through 1959 the risk for all forms of gastric resection for cancer was 6.2 per cent. for females and 8.2 per cent. for males. Operative risk increases somewhat as the size of the lesion increases and is higher when the lesion is in the cardia than when it is in the more distal part of the stomach. The operative risk is also higher for patients who have type C lesions (Dukes' classification) than for those with types A or B. A persisting observation over the years has been that operative mortality is higher among patients with achlorhydria than among those who have free hydrochloric acid in the gastric content. Thus, for the years 1940 through 1959 it was found that the operative mortality rate for gastric resection in patients with achlorhydria was 9.1 per cent.; for patients who had free hydrochloric acid up to thirty clinical units the mortality rate was 6.8 per cent., and for those who had more than thirty units the mortality rate was 2.1 per cent. There are no doubt many reasons for the variations in mortality rates which have been mentioned, many of which involve the realm of speculation or assumption but all of which have interesting connotations.

Survival Rates.

In our experience the two most important factors which influence survival rates after resection for gastric cancer are (1) the grade of the lesion and (2) the presence or absence of lymph node involvement. Thus, for 1950 through 1954 it was found that 57.9 per cent. of patients without metastasis to the lymph nodes survived five or more years after gastric resection in contrast with only 14.2 per cent. of those with metastasis to the lymph nodes. The influence of the grade of the lesion on survival rates is evidenced by the fact that for the same period, 1940 through 1954, 53 per cent. of patients with lesions of grade 1 or 2 survived five or more years after operation in contrast with only 26 per cent. of those with lesions of grade 3 or 4. The poorest prognosis occurs when there is a high-grade lesion with associated involvement of lymph nodes. Thus, only 12.1 per cent. of 692 patients who had resection, in the years 1940 through 1954, of a grade-4 lesion with lymph node involvement survived five years or more after operation. It is important, however, to realize that at least a few patients with this type of lesion survive for an appreciable time after operation. The situation is not a hopeless one.

Certain other factors such as the size and location of the lesion influence the survival rate after resection but to less degree than the grade and presence or absence of lymph node involvement. Thus, the five-year survival rate decreases as the size of the lesion increases. It was found to be higher when the lesion was situated on the lesser curvature of the stomach, in contrast with other areas in the stomach. It has also been observed that the five-year survival rate decreases as the gastric secretory level decreases.

TABLE 3.

FIVE-YEAR SURVIVAL RATES AFTER GASTRIC RESECTION IN DIFFERENT PERIODS.

PERIOD	PATIENTS TRACED	LIVED FIVE OR MORE YEARS AFTER LEAVING HOSPITAL	
		Number	Per Cent.
1907-1919 ...	636 ...	174 ...	27.4
1920-1929 ...	970 ...	299 ...	30.8
1930-1939 ...	854 ...	258 ...	30.2
1940-1944 ...	678 ...	253 ...	37.3
1945-1949 ...	808 ...	255 ...	31.6
1950-1954 ...	701 ...	207 ...	29.5

Survival rates according to various periods are shown in Table 3. With the exception of one five-year period (1940 through 1944), a remarkable similarity in survival rates for all other periods is apparent. One should keep in mind the facts, however, that operability and resectability rates have been increased as time has passed, and that operative mortality rates have been lowered. Thus, a higher percentage of patients with gastric cancer has undergone resection in later years than in earlier years. This is true despite the fact that the incidence of high-grade lesions and the presence of metastasis to the lymph nodes have increased. It is not surprising that the five-year survival rate, which is calculated on the basis of those patients who survived gastric resection, has not increased over the years. The fact remains, however, that of one hundred patients in whom the diagnosis of gastric cancer is made today, fifteen are expected to be alive at least five years from now. This number represents only a slight increase, the number being fourteen for the decade of 1940 through 1949. Although the survival rate after resection has declined, the proportion of the total patients with the diagnosis of gastric cancer who have survived for five years actually has increased a bit. This apparent paradox is explained by the fact that a considerably larger proportion of the total patients undergo resection than did in former years.

The data as presented on survival rates include all patients who had a gastric cancer resected, whether by subtotal or total gastrectomy. In a recent study of 275 patients who underwent total gastrectomy for gastric cancer and survived the operation, it was found that 14.9 per cent. were alive three years later, 9.9 per cent. five years later, and 7.9 per cent. ten years later. These data are similar to those reported in earlier studies (Fly et al., 1958; ReMine and Priestley, 1952).

SUMMARY.

National differences in the incidence and trends of incidence of gastric carcinoma might offer some clues regarding ætiologic factors of this disease if they could be properly evaluated. Although the relationship between "tumour

aggression" and lost resistance is an important factor in determining the prognosis for the patient who has cancer of the stomach, it is not the only factor to be considered. Early diagnosis and treatment also may influence prognosis. Principles of surgical treatment for gastric cancer are reviewed as are factors which influence operative mortality and survival rates. During recent years it has been found that of one hundred patients in whom the diagnosis of cancer is made, fifteen may be expected to be alive five years later if appropriate surgical treatment is carried out.

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